Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

forces do not give rise to any moment. Resolving parallel and perpendicular to the chassis,

$$F' + F\cos\alpha = C\cos\alpha'' + R\sin\alpha'',$$
$$F\sin\alpha = C\sin\alpha'' - R\cos\alpha'',$$

and taking moments about the center of mass,

$$F'd' - Fd\cos\alpha = S,$$

or making use of the relation between α and α'',

$$F' - F\sin(\alpha-\alpha'')/\sin\alpha'' = S/d'.$$

Solving these equations we obtain

$$R = -S/d'\sin\alpha'',$$
$$F = \sin\alpha''/\sin\alpha\ (C + S\cos\alpha''/d'),$$
$$F' = \sin(\alpha - \alpha'')/\sin\alpha\ C + S/d'\ (\sin(\alpha-\alpha'')\cos\alpha''/\sin\alpha - 1).$$

Now since $C = mv^2/\rho''$ and $S = mk^2d^2\psi/dt^2 = mk^2(d^2\theta/dt^2 + d^2\alpha''/dt^2)$ and in the method of steering assumed this is $mk^2d^2\theta''/dt^2 = mk^2v^2d^2\theta/ds^2$, if v is constant, both terms are proportional to v^2. Consequently the conclusions above stated are justified. (It is to be remarked that if v is constant, the kinetic reaction above is to be replaced by the force of traction necessary to maintain the velocity constant.) The term in C is proportional to the curvature, and the term in S to the rate of increase of curvature, the latter is greatest at the beginning and end of the curve, the former at the middle.

Finally I have made some experiments to determine the coefficient of friction μ of rubber on slimy stone, with the conclusion that it is about one-fourth. Using the criterion $v^2 < \mu g\rho$ we arrive at the conclusion that the safe speed for curves as above is somewhat less than ten miles per hour, which may account for the common traffic rule of "eight miles around the corner."

THE PROBABLE ERROR OF THE VITAL INDEX OF A POPULATION[1]

By JOHN RICE MINER

DEPARTMENT OF BIOMETRY AND VITAL STATISTICS, JOHNS HOPKINS UNIVERSITY

Communicated February 14, 1922

In comparing the birth-death ratios of different communities we need their probable errors to determine the significance of observed differences.

Let N = the population of a community,
B = number of births in a year,
D = number of deaths in a year.

Then the birth-death ratio or vital index is defined as $\frac{100\,B}{D}$.

The standard errors of sampling of births and deaths will be:

$$\sigma_B = \sqrt{\frac{B(N-B)}{N}} \qquad \sigma_D = \sqrt{\frac{D(N-D)}{N}}$$

whence $V_B = \frac{\sigma_B}{B} = \sqrt{\frac{1-B/N}{B}}$ $\qquad V_D = \frac{\sigma_D}{D} = \sqrt{\frac{1-D/N}{D}}$

and the probable error of the birth-death ratio will be[2]

$$PE_{\left\{\frac{100\,B}{D}\right\}} = 67.449\frac{B}{D}\sqrt{\frac{1-B/N}{B}+\frac{1-D/N}{D}} \tag{i}$$

since $r = 0$, being the correlation of errors of sampling of births and deaths. As B and D are small as compared with N we may write this approximately:

$$PE_{\left\{\frac{100\,B}{D}\right\}} = 67.449\frac{B}{D}\sqrt{\frac{1}{B}+\frac{1}{D}} \tag{ii}$$

This form has the advantage of not involving N, so that if the numbers of births and deaths in a community are known but not the population, the probable error of the birth-death ratio may still be found.

For Baltimore in 1917

$N = 594{,}637$

$B = 15{,}040$

$D = 11{,}355.$

Therefore by (i)

$$PE_{\left\{\frac{100\,B}{D}\right\}} = 67.449\,\frac{15040}{11355}\sqrt{\frac{1-\frac{15040}{594637}}{15040}+\frac{1-\frac{11355}{594637}}{11355}}$$

$$= 89.34\sqrt{\frac{0.9747}{15040}+\frac{0.9809}{11355}} = 89.34\ \sqrt{.00006481 + .00008638}$$

$$= 89.34 \times .01229 = 1.10.$$

By (ii)

$$PE_{\left\{\frac{100\,B}{D}\right\}} = 67.449\,\frac{15040}{11355}\sqrt{\frac{1}{15040}+\frac{1}{11355}} = 89.34\ \sqrt{.00006649 + .00008807}$$

$$= 89.34 \times .01243 = 1.11.$$

In using these formulae it should be borne in mind that the expression for the standard deviation of an index, which has been used in their derivation, is obtained on the assumption that deviations are small compared with the mean values of the variables. This will be true if B and D are of fair size, but the formulae should not be used for very small absolute numbers of births and deaths.

[1] Papers from the Department of Biometry and Vital Statistics, School of Hygiene and Public Health, Johns Hopkins University, No. 52.

[2] Pearson, K. On a form of spurious correlation which may arise when indices are used in the measurement of organs. *Proc. Roy. Soc.*, **60**, 1897 (489).

THE AVERAGE CHEMICAL COMPOSITION OF IGNEOUS ROCKS

By Frank W. Clarke and Henry S. Washington

U. S. Geological Survey* and Geophysical Laboratory of the Carnegie Institution of Washington

Communicated March 22, 1922

We have recently completed computations of the average chemical composition of the igneous rocks of various countries, of the continents, and of the earth's crust. These are to be published as a *Professional Paper* of the U. S. Geological Survey, with discussions of the characters of the various averages, of the relative abundance, distribution, association, and evolution of the elements, and other matters. Inasmuch as it is probable that this paper will not appear for a considerable time, it is thought best to publish now the various average compositions arrived at, in order to put before geologists and others some interesting data as to the chemical composition of the earth.

The data used by us were 5,159 chemical analyses of igneous rocks from all over the earth, and published between 1884 and 1913, inclusive. Analyses only of "superior" quality, and of fresh unaltered rocks, were considered. These were taken from a collection of rock analyses made by one of us.[1] In computing the averages of the various countries and the continents the sum total of each constituent was divided by the total number of analyses of rocks from the area dealt with. In the case of the earth average, both in terms of oxides and of elements, the same method was adopted for the major constituents, SiO_2, Al_2O_3, Fe_2O_3, FeO, MgO, CaO, Na_2O, K_2O and H_2O (only water above 110° was considered), while the average for the minor constituents was obtained by taking the mean of the sum total of each divided by the number of analyses (which gives too low a result) and by the number of determinations (which is apt to give too high a result).

In computing the average of the whole crust the relative proportions estimated by one of us[2] some years ago were adopted. The latest estimates of the masses and compositions of the hydrosphere and atmosphere have been used. These relative masses are as follows: Lithosphere 93%; hydrosphere 7%; atmosphere 0.03%.